

# FACTORY CALIBRATION PROCEDURE

## CONTENTS:

General	1
Equipment required	2
Factory test limits	3
Factory calibration procedure	5

## INTRODUCTION:

This is the guide for calibrating brand-new instruments, it therefore, calls out many procedures and adjustments that are rarely required for subsequent recalibration. *This procedure is company confidential.* In this procedure, all front panel control labels or Tektronix equipment names are in capital letters (VOLTS/DIV, etc.) internal adjustment labels are capitalized only (Gain Adj, etc.).

INCLUDES FACTORY  
TEST LIMIT CHANGES  
THROUGH DEC 3 1969

3B3

May 1966  
For all serial  
numbers.

Supersedes  
July 1963



## FACTORY TEST LIMITS:

We initially calibrate the instrument to Factory Test Limits. These limits are often more stringent than advertised performance requirements. This helps insure that the instrument will meet advertised requirements after shipment, allows for inaccuracies of test equipment used, and may allow for changes in environmental conditions.

## QUALIFICATION:

Factory test limits are qualified by the conditions specified in the main body of the calibration procedure. The numbers and letters to the left of the limits correspond to the factory calibration procedure steps where the check or adjustment is made. Instruments may not meet factory test limits if calibration or check-out methods and test equipment differ substantially from those in this procedure.

## ABBREVIATIONS:

Abbreviations in this procedure will be found listed in TEKTRONIX STANDARD A-100.

## CHANGE INFORMATION:

This procedure has been prepared by Product Manufacturing Staff Engineering. For information on changes that have been made to this procedure, to make suggestions for changing this procedure, or to order additional copies: please contact PMSE, 47-261. (NC)



## EQUIPMENT REQUIRED:

The following equipment is necessary to complete this procedure:

### a. TEKTRONIX Instruments

- 1 TYPE 531A OSCILLOSCOPE *422*
- 1 TYPE B PLUG-IN UNIT *423*
- 1 TYPE 561A OSCILLOSCOPE *561B*
- 1 TYPE 3A1 PLUG-IN UNIT *3A6*
- 1 TYPE 106 SQUARE-WAVE GENERATOR
- \* 1 TYPE 184 TIME MARK GENERATOR
- 1 TYPE 191 CONSTANT AMPLITUDE SIGNAL GENERATOR

### b. Test Fixtures and Accessories

- 1 50 $\Omega$  Coaxial Cable with BNC connectors (012-0057-00)
- 1 Plug-in extension (012-0066-00)
- 1 BNC to UHF Adapter (103-0032-00)
- 1 P6006 10X Passive Probe with Pincher tip (010-0128-00)  
(013-0071-00)
- 1 1K $\Omega$  1% resistor (309-0115-00)
- 1 600 VDC Variable Supply (Dwg #1421-A)

### c. Miscellaneous Equipment

- 1 20,000 $\Omega$ /VDC Multimeter

### d. Equipment for Sample Check

- 1 Low Frequency Sine Wave Generator (LFSWG) (067-0542-00)

\* This equipment must be traceable to NBS for instrument certification.

Substitute test equipment may be used. The Plant Staff Engineer must approve any substitutions. All equipment listed must perform within its manufacturer's specifications, unless otherwise stated.

It is assumed that all equipment is provided with BNC connectors; if equipment used has other than BNC connectors, adapters, not listed, may be needed.

# FACTORY TEST LIMITS

## QUALIFICATION

Factory test limits are qualified by the conditions specified in the main body of the calibration procedure. The numbers and letters to the left of the limits correspond to the factory calibration procedure steps where the check or adjustment is made. Instruments may not meet factory test limits if calibration or checkout methods and test equipment differ substantially from those in this procedure.

### 1. PRELIMINARY INSPECTION

### 2. VOLTAGE CHECKS

- b. 13.0-16.5V
- c. Check -6V:  $-6 \pm 1V$

### 3. SWEEP GATING THRESHOLD

### 4. ALTERNATE SWEEP

### 5. NORMAL AND DELAYED SWEEP TRIGGER

- a. Check Normal Internal Trigger:  
Sensitivity:  $\leq 0.2$  div  
LEVEL centering:  $\pm 30^\circ$  from 0
- b. Check Delayed Internal Trigger:  
Sensitivity:  $\leq 0.2$  div  
LEVEL Centering:  $\pm 30^\circ$  from 0
- c. Check Delayed External Trigger:  
Sensitivity:  $\leq 0.5V$ , X10  $\leq 5V$
- d. Check Normal External Trigger:  
Sensitivity:  $\leq 0.5V$ , X10  $\leq 5V$
- e. Check LEVEL Range:  $\geq +$  &  $- 15V$
- f. Check Trigger Overload:  $\geq \pm 500VDC$
- g. Check Normal HF Trigger:  
INT 5 MHz:  $\leq 0.2$  div  
INT 10 MHz:  $\leq 0.5$  div  
EXT 10 MHz:  $\leq 0.5$  V  
X10 EXT 10 MHz:  $\leq 5V$

5. (cont'd)

- h. Check Delayed HF Trigger:  
INT 5 MHz:  $\leq 0.2$  div  
INT 10 MHz:  $\leq 0.5$  div  
EXT 10 MHz:  $\leq 0.5V$   
X10 EXT 10 MHz:  $\leq 5V$
- i. Check Line Trigger: slope of display must correspond to the setting of the SLOPE switch
- j. Check LF Auto Trigger:  $\leq 10$  Hz
- k. Check Single Sweep

### 6. SWEEP GENERATOR

- \* b. Adjust SWEEP CAL: range: 5-15%  
above and below calibrated setting (depends on CRT SENS)
- c. Adjust Normal Sweep Length:  
10.2 - 10.8 div
- d. Check Variable TIME/DIV Ratio:  
 $\geq 2.5:1$
- e. Adjust Delayed Sweep Length:  
10.2 - 10.8 div

### 7. HORIZONTAL AMPLIFIER

- \* b. Adjust 5X Gain
- c. Check Magnified Timing Change:  $\leq \pm 1\%$
- d. Check Sweep Linearity:  $\leq \pm 1\%$
- e. Adjust Swp Mag Registration:  
 $\leq 0.2$  div shift from electrical center mag to norm
- f. Check position Range:  $\geq +$  &  $- 0.2$  div past CRT electrical center

### 8. DELAYED SWEEP TIMING

- \* b. Check Delayed Sweep Timing Accuracy  
(1s-50 $\mu$ s): 0.2s-50 $\mu$ s:  $\pm 2\%$   
0.5s & 1s:  $\pm 2.5\%$
- \* c. Check Delayed Sweep Timing Accuracy  
(20 s-0.5 $\mu$ s):  $\pm 2\%$ , with 5X  
MAG:  $\pm 3\%$

## 9. DELAY TIME

- \* b. Adjust Delay Start and Stop
- \* c. Check Delay Time Linearity:  $\pm 0.8$   
minor div

## 10. NORMAL SWEEP TIMING

- \* a. Check Normal Sweep Timing ( $50\mu\text{s}$ - $0.2\text{s}$ ):  
 $\pm 0.625\%$  of DELAY DIAL full scale
- \* b. Check Normal Sweep Timing ( $0.5$  &  $1\text{s}$ ):  
 $\pm 2.5\%$
- \* c. Check Normal Sweep Timing ( $5\mu\text{s}$ - $20\mu\text{s}$ ):  
 $\pm 0.625\%$  of DELAY DIAL full scale
- \* d. Check Normal Sweep Timing ( $0.5$ - $2\mu\text{s}$ ;  
 $0.5$  &  $1\text{s}$ ):  $\pm 2\%$
- \* e. Check Normal Sweep Magnified Timing:  
Accuracy:  $\pm 3\%$   
Linearity:  $\pm 1\%$

## 11. DELAY JITTER

$\leq 1$  part in 50,000 @ 1.00  
 $\leq 1$  part in 25,000 @ 9.00 } of total delay time

## 12. DELAYED SWP SHIFT

$\pm 250\text{ns}$

## 13. HOLDOFF

Check Normal Sweep Holdoff:	
TIME/DIV	Holdoff
.5, 1 & $2\mu\text{SEC}$	5-10 $\mu\text{s}$
5, 10 & $20\mu\text{SEC}$	10-25 $\mu\text{s}$
50 SEC, .1 & .2mSEC	40-170 $\mu\text{s}$
.5, 1 & 2mSEC	0.5 -1.5ms
5, 10 & 20mSEC	5-10ms
50mSEC, .1, .2, .5 & 1 SEC	50-100ms

## 14. SAWTOOTH CURRENT

- b. Check Sawtooth Current:  $60$ - $70\mu\text{A}/\text{div}$
- \* Indicates measurement characteristic; test equipment  
used must be traceable to NBS for instrument certification.

1. PRELIMINARY INSPECTION*a. General Inspection*

Check for unsoldered joints, rosin joints, lead dress and long leads. Check for loose hardware and protruding parts. Check controls for smooth mechanical operation, proper indexing, and knob spacing from front panel.

*b. Check DELAY TIME Dial*

Turn DELAY TIME full ccw until it hits the stop and check for a dial reading of 0.00.

If dial does not read 0.00 at ccw stop, loosen dial set screw and reposition dial on shaft. Tighten set screw and check that dial operates smoothly throughout its range.

*c. Preset TYPE 3B3 Control*

POSITION	midr
5X MAG	off
MODE	NORM

NORMAL SWEEP TIME/DIV	1mSEC
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DELAYED SWEEP TIME/DIV	1mSEC
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VARIABLE	CALIB
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DELAY TIME	midr
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SWEEP CAL	midr
-----------	------

LEVEL (both)	cw
SLOPE (both)	+

COUPLING (both)	AC
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SOURCE (both)	INT
EXT TRIG ATTEN	push in
NORM/SINGLE SWP	NORM

Threshold, R130 and R230	90° cw from midr
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All other internal adjustments	midr
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Leave controls and adjustments, for any step as they were in the step preceding unless otherwise noted.

## 1. (cont'd)

d. *Check Amphenol Plug Resistance*

Check resistances to GND. (-meter lead connected to GND)

<u>Use</u>	<u>Amphenol pin</u>	<u>Approx resistance</u>
6.3 VAC	1, 2	75 $\Omega$
unused	3	inf
multi-trace		
sync pulse	4	5k $\Omega$
GND	5	0 $\Omega$
300V	6	45k $\Omega$ <i>replaced</i>
unused	7, 8	inf
GND	9	0 $\Omega$
300V	10	45k $\Omega$ <i>replaced</i>
unused	11	inf
int trig sig	12	inf
unblanking pulse	13	60k $\Omega$ <i>replaced</i>
intensifying		
pulse	14	3k $\Omega$
+125V	15	5k $\Omega$
-12.2V	16	3 $\Omega$
output	17	60k $\Omega$
SAWTOOTH		
CURRENT	18	120k $\Omega$
GND	19	0 $\Omega$
+125V	20	5k $\Omega$
output	21	65k $\Omega$
GND	22	0 $\Omega$
-100V	23	4.5k $\Omega$
unused	24	inf

d. Pins 18 and 19 read inf and are not used on serial numbers below 4270.

2. ZENER VOLTAGEa. *Setup*

Place the TYPE 3A1 into the vertical compartment of the TYPE 561A. Connect the TYPE 3B3 to the horizontal compartment of the TYPE 561A via a plug-in extension. Turn power on. Allow the equipment to operate for 15 min before continuing.

b. *Check Zener Voltage 13.0-16.5V*

Check voltage from D398 cathode to GND: +13.0V to 16.5V.

c. *Check -6V: -6V  $\pm$  1V*

Check voltage at pin 4 of V161. Must be -6V  $\pm$  1V. If not, change V414 or V161.

### 3. SWEEP GATING THRESHOLD

#### *a. Setup*

Preset controls as follows:

MODE NORM

normal sweep

SOURCE EXT

Connect a shorting strap across R143  
(17.8k $\Omega$ ).

#### *b. Adjust Normal Swp Gating Threshold R130*

Adjust Normal Swp Gating Threshold R130  
until the sweep just free runs. Check  
for same setting of R130 at all sweep  
speeds.

Remove the short from R143 and check that  
trace disappears. Check at all sweep speeds.

#### *c. Adjust Delayed Swp Gating Threshold*

Preset controls as follows:

normal sweep

COUPLING AUTO

delayed sweep

SOURCE EXT

MODE TRIG DLY'D SWP

DELAYED SWEEP

TIME/DIV 1mSEC

Connect a shorting strap across R243  
(17.8k $\Omega$ ).

Adjust Delayed Swp Gating Threshold R230  
until the sweep just free runs.

Remove the short from R243 and check that the  
trace disappears. Check at all sweep speeds.

### 4. ALTERNATE SWEEP

Remove plug-in extension and insert the TYPE  
3B3 into scope. Set MODE to NORM.

Set the TYPE 3A1 MODE switch to ALTER. Check  
for an alternate sweep in all TIME/DIV settings  
with TYPE 3B3 MODE in NORM and DLY'D SWP.

Return TYPE 3A1 MODE switch to CH 1.

## 5. NORMAL AND DELAYED TRIGGER

### a. Check Normal Internal Trigger

Sensitivity:  $\leq 0.2$  div

LEVEL:  $\pm 30^\circ$  from 0

Set the MODE to NORM and the normal sweep SOURCE to INT. Connect the test scope CAL OUT to the TYPE 3A1 CH 1 input. Adjust the AMPLITUDE CALIBRATOR and the TYPE 3A1 VOLTS/DIV to provide a 0.2 div display.

Check for stable triggering, in + and - SLOPE, by adjusting the LEVEL control, with the COUPLING set to AUTO, AC and DC. Stable triggering in AUTO and AC must occur with the LEVEL control within  $\pm 30^\circ$  of 12 o'clock.

Check for stable triggering in DC with the display at the top and bottom of the graticule area.

### b. Check Delayed Internal Trigger

Sensitivity:  $\leq 0.2$  div

LEVEL:  $\pm 30^\circ$  from 0

Change the MODE to TRIG DLY'D SWP, delayed sweep SOURCE to INT and normal sweep COUPLING to AUTO. Set the normal TIME/DIV to .5mSEC and the delayed TIME/DIV to .2mSEC. Check for stable triggering in + and - SLOPE, by adjusting the LEVEL control, with the COUPLING in AD and DC.

Stable triggering in AC must occur with the LEVEL control within  $\pm 30^\circ$  of 12 o'clock. Check DC triggering with the display at the top and bottom of the graticule area.

### c. Check Delayed External Trigger

Sensitivity:  $\leq 0.5V$ ,  $\times 10 \leq 5V$

Connect the test scope CAL OUT to the TYPE 3A1 input and the delayed sweep EXT TRIG input. Set the test scope AMPLITUDE CALIBRATOR to .5 VOLTS. Check for stable triggering by adjusting the LEVEL control, in + and - SLOPE, AC and DC coupled.

Pull out the EXT TRIG ATTEN (LEVEL knob). Check that the display will not trigger with any setting of the LEVEL control. Change the test scope AMPLITUDE CALIBRATOR to 5 VOLTS. Check that stable triggering can be obtained by adjusting the LEVEL control. Push in the EXT TRIG ATTEN.



## 5. (cont'd)

*d. Check Normal External Trigger**Sensitivity:  $\leq 0.5V$ ,  $\times 10 \leq 5V$* 

Change the MODE to NORM and connect the test scope CAL OUT to the normal sweep EXT TRIG input. Check the normal sweep external trigger as was done in step 5e for the delayed sweep.

Remove the calibrator signal from the TYPE 3A1 and EXT TRIG input and push in the EXT TRIG ATTEN.

*e. Check LEVEL range  $\geq +$  &  $- 15V$* 

Connect the HI AMPLITUDE OUTPUT of the TYPE 106 to the TYPE 3A1 and normal EXT TRIG input. Adjust the TYPE 106 frequency to 1 kHz, AMPLITUDE to 30V P to P and SYMMETRY for 50% duty cycle.

Check that display will not trigger with extreme cw and ccw settings of the LEVEL control.

Change the MODE to TRIG DLY'D SWP, connect the TYPE 106 OUTPUT to the delayed sweep EXT TRIG input and repeat the check for the delayed sweep LEVEL control. Remove the TYPE 106 signal from the TYPE 3A1 and EXT TRIG input.

*f. Check Trigger Overload  $\geq \pm 500$  VDC*

Connect the output of the special Variable DC Supply to the delayed sweep EXT TRIG input. Set the delayed sweep SOURCE to EXT and COUPLING to AC. Adjust the Variable DC Supply for +500 VDC. Depress the ON button, hold down for approx 5 seconds and release. Change the Variable DC Supply to -500 VDC and repeat the check.

Change the MODE to NORM, the normal sweep COUPLING to AC and SOURCE to EXT. Connect the Variable DC Supply to the normal EXT TRIG input. Check + and - overload as was done for the delayed sweep trigger.

Remove the Variable DC Supply from the EXT TRIG input.

5f. This is an operational check of the protection circuitry. A component failure should be apparent when the high frequency trigger requirements are checked.

## 5. (cont'd)

## g. Check Normal HF Trigger

int 5 MHz:  $\leq 0.2$  div  
 int 10 MHz:  $\leq 0.5$  div  
 ext 10 MHz:  $\leq 0.5$  volts  
 ext X10 10 MHz:  $\leq 5$  volts

Connect the TYPE 191 to a 50 $\Omega$  coaxial cable -- 50 $\Omega$  Termination -- BNC T

connector { -- normal sweep EXT TRIG  
 -- TYPE 3A1 CH 1 input

Set the TYPE 3A1 CH 1 VOLTS/DIV to 1.  
 Check for stable triggering in + and - SLOPE, with the following control settings and input signals.

normal sweep		TYPE 191	
COUPLING	SOURCE	Frequency	Amplitude
AC	INT	5 MHz	0.2 div
DC	INT	5 MHz	0.2 div
AUTO	INT	5 MHz	0.2 div
AUTO	INT	10 MHz	0.5 div
DC	INT	10 MHz	0.5 div
AC	INT	10 MHz	0.5 div
AC	EXT	10 MHz	0.5 div

Pull out the EXT TRIG ATTEN.

AC	EXT	10 MHz	5 volts
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## h. Check Delayed Sweep HF Trigger

int 5 MHz:  $\leq 0.2$  div  
 int 10 MHz:  $\leq 0.5$  div  
 ext 10 MHz:  $\leq 0.5$  volts  
 ext X10 10 MHz:  $\leq 5$  volts

Change the MODE to TRIG DLY'D SWP. Connect the TYPE 191 signal to the delayed sweep EXT TRIG input. Check for stable triggering in + and - SLOPE with the following control settings and input signals:

delayed sweep		TYPE 191	
COUPLING	SOURCE	Frequency	Amplitude
Pull out the EXT TRIG ATTEN.			
AC	EXT	10 MHz	5 volts
Push in the EXT TRIG ATTEN.			
AC	EXT	10 MHz	0.5 volts
AC	INT	10 MHz	0.5 div
DC	INT	10 MHz	0.5 div
DC	INT	5 MHz	0.2 div
AC	INT	5 MHz	0.2 div

Remove the TYPE 191 signal from the TYPE 3A1 and EXT TRIG input.

## 5. (cont'd)

*i. Check Line Trigger*

Set the front panel controls as follows:

MODE	NORM
TIME/DIV (normal)	2mSEC
TRIGGER (normal)	
COUPLING	AC
SOURCE	LINE
SLOPE	+

Connect a 10X probe to the TYPE 3A1 CH 1 input. Set the CH 1 VOLTS/DIV to 5. Connect the probe tip to 117 VAC on the TYPE 561A power connector. Adjust the LEVEL control for a stable triggered display.

Check that the slope of the display corresponds to the + and - settings of the SLOPE switch.

With the TIME/DIV set at 2mSEC, vary the LEVEL control and/or the VARIABLE TIME/DIV so the sweep ends on the same slope that it is triggered on. Check that the display does not double trigger (see notes).

- i. A double trigger may indicate that D101 (normal sweep) or D201 (delayed sweep) is open.

Change the TIME/DIV to 10mSEC and the DELAY TIME RANGE to 5mSEC. Change the MODE to INTEN (TRIG) and adjust the DELAYED SWEEP TRIGGER LEVEL for a triggered intensified display. Adjust the DELAY TIME so the intensified portion of the sweep starts to jump between the second and third positive going edge of the 60Hz sine-wave. Set the DELAY TIME so the intensified portion of the sweep is just triggered on the third positive going edge. Change the MODE to DLY'D SWP (TRIG) and check that the display does not double trigger (see notes).

Change the MODE to NORM and remove the 10X probe.

j. *Check Low Frequency Auto Trigger*  
 $\leq 10$  Hz

Apply .1 S time marks from the TYPE 184 to the TYPE 3A1 input. Set the front panel controls as follows:

TIME/DIV (normal)	5mSEC
TRIGGER (normal)	
COUPLING	AUTO
SLOPE	+
SOURCE	INT

Check that a stable triggered display can be obtained by adjusting the LEVEL control.

Remove the TYPE 184 signal.

k. *Check Single Sweep*

Set the front panel controls as follows:

normal sweep	
COUPLING	AC
SOURCE	INT
TIME/DIV	.5mSEC

Connect the test scope CAL OUT to the TYPE 3A1 CH 1 input. Adjust the CH 1 VOLTS/DIV and the test scope AMPLITUDE CALIBRATOR for a 1 minor div display. Adjust the normal sweep LEVEL control for a triggered display. Remove the calibrator signal from the CH 1 input. Change the NORM, SINGLE SWEEP switch to SINGLE SWEEP. Check that the READY neon

5k. (cont'd)

is extinguished. Push the NORM, SINGLE SWEEP switch to RESET and release. Check that the READY neon is lit. Reconnect the calibrator signal to the CH1 input. Check that a single sweep occurs and the READY neon extinguishes. Repeat the check several times to insure correct operation.

## 6. SWEEP GENERATOR

### a. Setup

Preset the front panel controls as follows:

Trigger	MODE	NORM
	normal sweep	
	SOURCE	INT
	COUPLING	AUTO
	SLOPE	+
	TIME/DIV	1mSEC

Connect the MARKER OUTPUT of the TYPE 184 to the TYPE 3A1 CH 1 input. Set the TYPE 184 for .1mS and 1mS markers.

### \* b. Adjust SWEEP CAL

Rotate the SWEEP CAL adjustment throughout its range. Check for the correct range of adjustment above and below the calibrated setting (one 1mS mark/major div).

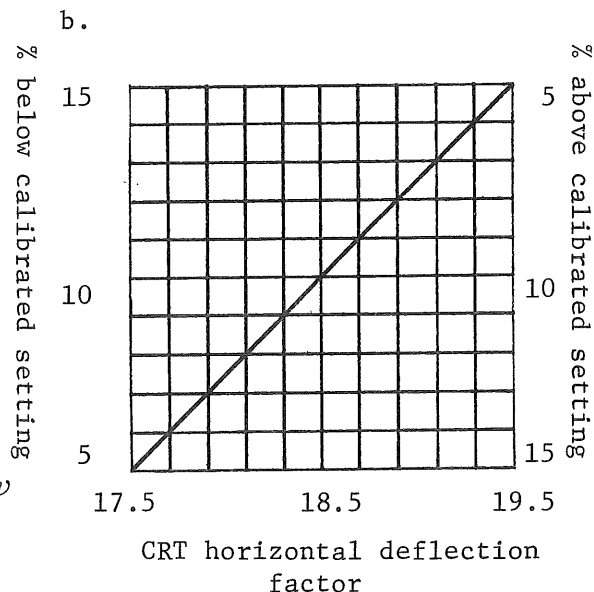
Adjust the SWEEP CAL for one 1mS mark/major div.

### c. Adjust Normal Sweep Length 10.2-10.8 div

Adjust the Normal Swp Length (R168) for a trace length of 10.5 div.

### d. Check Variable Time/Div Ratio $\geq 2.5:1$

Change the TYPE 184 time marks to 10mS. Slowly turn the VARIABLE control full ccw. There must be a smooth change in timing and the UNCAL neon must be lit when the VARIABLE is out of the CALIB detent. The distance between the first two time marks when the VARIABLE is full ccw must be  $\leq 4$  div.



## 6. (cont'd)

- e. *Adjust Delayed Sweep Length*  
10.2-10.8 div

Set the front panel controls as follows:

MODE

delayed sweep *Trigger*

SOURCE INT

SLOPE +

TIME/DIV 1mSEC

normal sweep

TIME/DIV 2mSEC

DELAY TIME approx 3.00

Change the TYPE 184 time marks to 1mS and .1mS. Adjust the delayed sweep LEVEL for a stable display. Adjust the Delayed Swp Length (R268) for 10.5 div trace length.

## 7. HORIZONTAL AMPLIFIER

- a. *Setup*

Change the MODE to NORM and the normal sweep TIME/DIV to 1mSEC. Set the TYPE 184 for 0.1ms, 1ms and 5ms time marks.

- \* b. *Adjust 5X Gain*

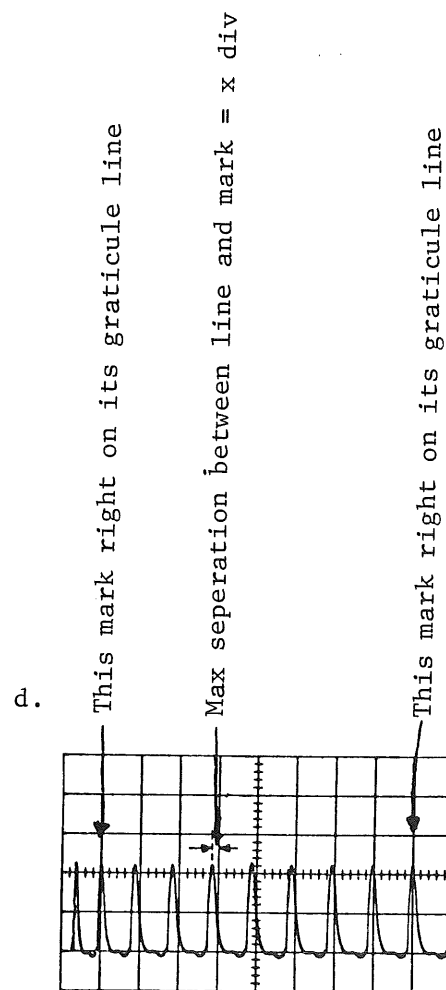
Pull out the 5X MAG (POSITION) and position the middle 5ms time mark to the center graticule line. Adjust the 5X Gain (R355) for two 0.1ms time marks/major div.

- c. *Check Magnified Timing Change  $\leq \pm 1\%$*

Check the timing for each 10cm segment of the magnified sweep. The timing error for any segment must not exceed  $\pm 1\%$ .

- d. *Check Sweep Linearity  $\leq \pm 1\%$*

Check the sweep linearity, over the middle 8cm, for each 10cm segment of the magnified sweep. The non-linearity for any segment must not exceed 1%.



$$\text{Percent nonlinearity} = \frac{X \text{ div}}{8 \text{ div}} \times 100$$

## 7. (cont'd)

e. *Adjust Sweep Mag Registration*  
*≤ 0.2 div shift*

Locate the CRT horizontal electrical center by shorting the horizontal deflection plates together. Position the middle 5ms time mark to the CRT horizontal electrical center. Push the 5X MAG (POSITION control) in and adjust the Swp Mag Regis (R368) so the middle 5ms time mark falls on the CRT horizontal electrical center.

Repeat the Swp Mag Regis adjustment until the middle 5ms time mark remains at the CRT electrical center when the 5X magnifier is turned on and off.

f. *Check Position Range*  
*≥ + & - 0.2 div*

Turn the 5X MAG off. Turn the POSITION control full cw. The start of the trace must position at least 0.2 div to the right of the CRT electrical center.

Turn the POSITION control full ccw. The end of the trace must position at least 0.2 div to the left of the CRT electrical center.

8. DELAYED SWEEP TIMINGa. *Setup*

Set the TYPE 184 for 50μs time marks. Change the TIME/DIV to 50μSEC and adjust the normal sweep LEVEL control for a triggered display. Change the MODE to TRIG DLY'D SWP and adjust the delayed sweep LEVEL control for a triggered display. Adjust the DELAY TIME control for approx 10cm sweep length.

\* b. *Check Delayed Sweep Timing Accuracy*  
*(1s-50μs) 0.2s-50μs: ±2%*  
*0.5s & 1s: ±2.5%*

Check the delayed sweep timing accuracy with the controls set as follows:

8b. (cont'd)

<u>TIME/DIV</u> <u>(both)</u>	<u>TYPE</u> <u>184</u>	<u>Marks/</u> <u>div</u>	<u>Max error</u>
50μSEC	50μS	1	0.16 div
.1mSEC	.1mS	1	0.16 div
.2mSEC	.1mS	2	0.16 div
.5mSEC	.5mS	1	0.16 div
1mSEC	1mS	1	0.16 div
2mSEC	1mS	2	0.16 div
5mSEC	5mS	1	0.16 div
10mSEC	10mS	1	0.16 div
20mSEC	10mS	2	0.16 div
50mSEC	50mS	1	0.16 div
.1 SEC	.1 S	1	0.16 div
.2 SEC	.1 S	2	0.16 div
.5 SEC	.5 S	1	0.2 div
1 SEC	1 S	1	0.2 div

c. *Check Delayed Sweep Timing*

(20μs-0.5μs) ±2%

5X MAG: ±3%

Check or adjust the delayed sweep timing accuracy with the controls set as follows:

<u>TIME/DIV</u> <u>(both)</u>	<u>TYPE</u> <u>184</u>	<u>adjust</u>	<u>check or</u> <u>adjust for</u>
1μSEC	1μS	C260B	1 mark/div ±0.16 div
.5μSEC	.5μS		1 mark/div ±0.16 div

† Check timing accuracy for each 10 div segment of the magnified sweep. Exclude the first two and last five time marks.

Turn the 5X MAG on.

.5μSEC	.1μS	†1 mark/div ±0.24 div
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Check the incremental linearity between the 1st and 2nd time mark. There must be 0.9 to 1.1 div between the 1st and 2nd time mark.

Turn the 5X MAG off.

2μSEC	1μS	2 marks/div ±0.16 div
10μSEC	10μS	C260D 1 mark/div ±0.16 div
20μSEC	10μS	2 marks/div ±0.16 div
5μSEC	5μS	1 mark/div ±0.16 div



## 9. DELAY TIME

*a. Adjust Delay Start and Stop (rough)*

Set the front panel controls as follows:

MODE	INTEN (not trig)
Normal TIME/DIV	1mSEC
Delayed TIME/DIV	10μSEC
SLOPE	+
COUPLING	AC
SOURCE	INT

Set the TYPE 184 for 1mS time marks.  
Adjust the Normal trigger LEVEL control for a triggered display. Set the DELAY TIME control to 1.00 and adjust the Delay Start (R430) so the intensified part of the sweep starts on the 2nd time mark (time = 1ms).

Set the DELAY TIME control to 9.00 and adjust the Delay Stop (R439) so the intensified part of the sweep starts on the 10th time mark (time = 9ms).

*\* b. Adjust Delay Start and Stop (fine)*

Change the MODE to DLY'D SWP. With the DELAY TIME still at 9.00, adjust the Delay Stop so the leading edge of the 10th time mark starts at the beginning of the trace.

Set the DELAY TIME to 1.00. Adjust the Delay Start so the leading edge of the 2nd time mark starts at the beginning of the trace.

The Delay Start and Delay Stop adjustments interact and it will be necessary to repeat the adjustments several times.

*c. Check Delay Time Linearity*  
*±0.8 minor div*

9c. 50 minor div = one turn of the DTM dial.

Adjust the DELAY TIME so the sweep starts on the leading edge of the 2nd time mark (approx 1.00). Note the dial reading.  
Adjust the DELAY TIME so the sweep starts on the leading edge of the 3rd time mark (approx 2.00). Note the dial reading. The difference between the two noted readings must be 49.2 to 50.8 minor div.

Repeat this check for each major dial division from 1.00-9.00 (i.e. 2.00 to 3.00, 3.00 to 4.00, etc).

# 10. NORMAL SWEEP TIMING

- \* a. Check Normal Sweep Timing  
(50μSEC-.2 SEC) ±0.625%

Set the normal sweep TIME/DIV to 50μSEC  
and the delayed sweep TIME/DIV to 5μSEC.  
Set the TYPE 184 for 50μS time marks.  
Adjust the DELAY TIME so the sweep starts  
on the leading edge of the 2nd time mark.  
Note the dial reading. Adjust the DELAY  
TIME so the sweep starts on the leading  
edge of the 10th time mark. Note the dial  
reading. The difference between the two  
dial readings must be ~~400 ± 2.5~~ minor div.

800 ± 5

Repeat this procedure to check the normal  
sweep timing with the following control  
settings:

TIME/DIV (normal)	TIME/DIV (delayed)	TYPE 184	max error (minor div on delay dial)
.1mSEC	10μSEC	.1mS	±2.5
.2mSEC	10μSEC	.1mS	±2.5
.5mSEC	50μSEC	.5mS	±2.5
1mSEC	.1mSEC	1mS	±2.5
2mSEC	.1mSEC	1mS	±2.5
5mSEC	.5mSEC	5mS	±2.5
10mSEC	1mSEC	10mS	±2.5
20mSEC	1mSEC	10mS	±2.5
50mSEC	5mSEC	50mS	±2.5
.1 SEC	10mSEC	.1 S	±2.5
.2 SEC	10mSEC	.1 S	±2.5

± 5



- \* b. Check Normal Sweep Timing (.5 & 1 SEC)  
±2.5% Magnified: ±3%

Change the MODE to NORM. Check the normal  
sweep timing accuracy with the controls set  
as follows:

TIME/DIV (normal)	TYPE 184	check for
.5 SEC	.5 S	1 mark/div ±0.2 div
1 SEC	1 S	1 mark/div ±0.2 div

Turn the 5X MAG on.

.5 SEC	.1 S	1 mark/div ±0.24 div
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- a. A difference in main frame -100V  
supplies will cause an error  
in timing accuracy. i.e., if  
the Delay Start and Delay Stop  
is adjusted in one main frame  
and the timing accuracy checked  
in another, there may be a  
timing error unless the Delay  
Start and Delay Stop are re-  
adjusted.

## 10. (cont'd)

- \* c. *Check/Adjust Normal Sweep Timing*  
(5 $\mu$ SEC to 20 $\mu$ SEC)  $\pm 0.625\%$

Change the MODE to NORM, normal TIME/DIV to 10 $\mu$ SEC and the delayed TIME/DIV to 1 $\mu$ SEC.  
Set the TYPE 184 for 10 $\mu$ S time marks.  
Adjust Cl60D for 1 mark/div. Return the MODE to DLY'D SWP. Adjust the DELAY TIME so the sweep starts on the leading edge of the 2nd time mark.

Note the DELAY TIME dial reading. Increase the DELAY TIME dial reading exactly ~~400~~ <sup>800</sup> minor div. Adjust Cl60D so the sweep starts on the leading edge of the 10th time mark.

Check the normal sweep timing, as was done in step a, with the following control settings:

TIME/DIV (normal)	TIME/DIV (delayed)	TYPE 184	max error (minor div)
20 $\mu$ SEC	1 $\mu$ SEC	10 $\mu$ S	$\pm 2.5 \pm 5$
5 $\mu$ SEC	.5 $\mu$ SEC	5 $\mu$ S	$\pm 2.5 \pm 5$

- \* d. *Check Normal Sweep Timing* (0.5-2 $\mu$ SEC;  
.5 & 1 SEC)  $\pm 2\%$

Change the MODE to NORM. Check the normal sweep timing accuracy with the controls set as follows:

TIME/DIV	TYPE	adjust	check or adjust for
both	184		
1 $\mu$ SEC	1 $\mu$ S	Cl60B	1 mark/div $\pm 0.16$ div
2 $\mu$ SEC	1 $\mu$ S		2 marks/div $\pm 0.16$ div
.5 $\mu$ SEC	.5 $\mu$ S		1 mark/div $\pm 0.16$ div

- \* e. *Check Normal Sweep Magnified Timing*  
accuracy:  $\pm 3\%$   
linearity:  $\pm 1\%$

Change the TYPE 184 time marks to .1 $\mu$ S and turn 5X MAG on. Check the entire magnified sweep (with the exception of the first 50ns) for 1 mark/div  $\pm 0.24$  div.

Check each 10 div segment of the sweep for a linearity of  $\pm 1\%$  (see step 7d).

Check for 0.9 to 1.1 div between the 1st and 2nd time mark.

## 11. DELAY JITTER

<1 part in 50,000 @ 1.00

<1 part in 25,000 @ 9.00

Set the front panel controls as follows:

TIME/DIV (normal)	1mSEC
TIME/DIV (delayed)	1μSEC
MODE	DLY'D SWP
DELAY TIME	1.00
5X MAG	OFF

Change the TYPE 184 time marks to 1mS.

Adjust the DELAY TIME to display the leading edge of the 2nd time mark. The horizontal jitter must not exceed 0.2 div.

Turn the DELAY TIME to approx 9.00 to display the leading edge of the 10th time mark. The horizontal jitter must not exceed 0.4 div.

## 12. DELAYED SWP SHIFT      ±250ns

Set the front panel controls as follows:

MODE	NORM
TIME/DIV (both)	1μSEC
DELAY TIME	1.00

Change the TYPE 184 time marks to 1μS. Adjust the normal sweep LEVEL control so the sweep starts on an easy to identify point on the 1st time mark.

Change the MODE to DLY'D SWP and turn the DELAY TIME until the sweep starts at the same point as noted before.

The DELAY TIME dial must read between 0.75 and 1.25.

Remove the TYPE 184 signal.

## 13. HOLDOFF

### *a. Setup*

Set the MODE to NORM and the normal sweep COUPLING to AUTO. Connect a 10X probe from the test scope to the CRT right-hand deflection plate lead. Set the test scope vertical input coupling to AC and deflection factor to 5 V/CM.

## 13. (cont'd)

*b. Check Normal Sweep Holdoff*

Check for the specified holdoff time with the controls set as follows:

TIME/DIV	Holdoff time
.5, 1 & 2 $\mu$ SEC	5-10 $\mu$ s
5, 10 & 20 $\mu$ SEC	10-25 $\mu$ s
50 $\mu$ SEC, .1 & .2mSEC	40-170 $\mu$ s
.5, 1 & 2mSEC	0.5 01.5ms
5, 10 & 20mSEC	5-10ms
50mSEC, .1, .2, .5 & 1 SEC	50-100ms

## 14. SAWTOOTH CURRENT

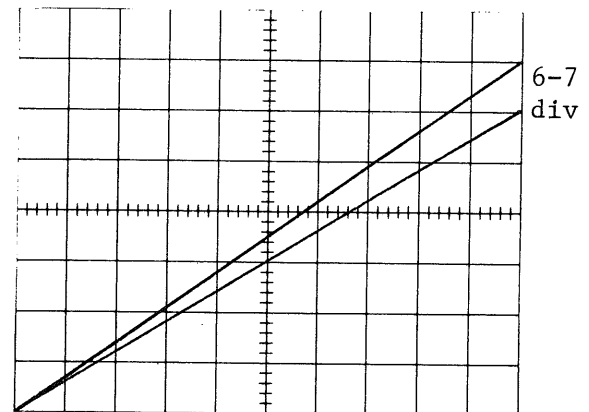
*a. Setup*

Change the TIME/DIV to 1mSEC. Set the TYPE 3A1 CH1 VOLTS/DIV to .1, DC coupled. Connect a 1k $\Omega$  1% resistor between GND and pin 18 on the TYPE 3B3 amphenol plug. Connect a test lead (e.g. meter lead) from pin 18 of the amphenol plug to the TYPE 3A1 input.

*b. Check Sawtooth Current*

60-70 $\mu$ A/div

Adjust the HORIZONTAL and VERTICAL POSITION control so the displayed ramp waveform starts at the bottom left-hand corner of the graticule. The ramp waveform must rise 6.0 to 7.0 vertical div in 10 horizontal div.



THE FOLLOWING CHECKS ARE NOT DONE ON 100% OF THE INSTRUMENTS BUT ARE DONE ON A SAMPLE BASIS.

#### 15. CHECK LOW FREQUENCY TRIGGERING

Connect the LFSWG through a cable to a BNC T connector to CH1 of the TYPE 3A1. Connect the unused end of the T connector to normal sweep EXT TRIG of the TYPE 3B3. Adjust the LFSWG for 0.5V of 10Hz and set the TYPE 3B3 TIME/DIV to 50mSEC. Check normal and delayed sweep for stable triggering with coupling switches in AC and SOURCE in EXT.

THE END